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AUSTRALIAN WHEAT VARIETIES IN THE PACIFIC COAST AREA.

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Several varieties of Australian wheat are important commercially in the Pacific coast area of the United States. Many others have been or are now under experiment at the agricultural experiment stations in this area. This bulletin gives the history of the introduction of Australian varieties into the United States, describes them briefly, and presents the results of experiments with them at the Sherman County Branch Station at Moro, in the Columbia Basin of Oregon, and at the Plant Introduction Station at Chico, in the Sacramento Valley of California. Results of nursery experiments with 130 lots of Australian wheat recently introduced by the United States Department of Agriculture are presented also. Of these the Federation group, consisting of three varieties, Federation, Hard Federation, and White Federation, appears best adapted. The history and descriptions of these varieties are given, and also the experimental results thus far obtained with them in comparison with commercial varieties.

Nearly all Australian varieties are white spring wheats. This type in the United States is grown only in the Pacific coast and Inter-

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mountain areas. In Australia all wheat is fall sown. The mild climatic conditions there are quite similar to those in California, where all wheat is sown also in the fall. The Australian varieties, therefore, are grown as fall wheats in California. In most parts of Oregon and Washington, however, they can be grown only as spring wheats.

HISTORY OF INTRODUCTIONS.

WHITE AUSTRALIAN AND PACIFIC BLUESTEM.

One variety at least of Australian wheat has been grown in the Pacific coast area for nearly 70 years. The White Australian variety was introduced into the United States from Australia in the early fifties. During the period from 1852 to 1866 [1] its culture became established in California. Since that time it has remained the principal variety grown in that State. A similar variety has been grown in Oregon and Washington since the early eighties. According to Mr. W. P. Church, of Walla Walla, Wash., this wheat came from two introductions received under the name of Purple Straw Tuscan. The first introduction was obtained from Australia in 1884 and the second from New Zealand in 1896. The second introduction, he states, "consisted of 14 sacks and contained a mixture of 10 to 15 per cent of red kernels contained in bearded heads." The seed was distributed to farmers and the variety gained rapidly in popularity, being grown under the name "Bluestem." It is not known how this name came to be applied to the variety, as it does not have the purple straw common to many varieties of wheat and is not similar to any of the other five varieties grown in the United States under this name. It also is not similar to the Purple-Straw Tuscan wheat of Australia, but is very much like the White Tuscan and Silver King varieties of that country. The White Tuscan was the leading commercial variety of Australia before it was replaced by the Federation. To distinguish this Bluestem wheat from other Bluestem varieties it has recently been called Pacific Bluestem. In Washington and Oregon the Pacific Bluestem wheat became as popular as the White Australian did earlier in California, and until recent years it has been the principal spring wheat grown in the "Inland Empire." Although only soft to semihard in kernel texture, these two similar or identical varieties have been considered to possess good milling qualities when compared with other white wheats. They are beardless and have glabrous white chaff, do not shatter easily, and have tall, strong straw. Under favorable conditions they yield very heavily and for that reason have continued in cultivation.

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[1] Showrds, Thomas. [Letter.] *In* U. S. Comr. Patents Rpt., 1852, pt. 2, Agr., p. 176. 1853.
Appleton, F. G. [Letter.] *In* U. S. Comr. Patents Rpt., Agr., 1854, p. 138. 1855.
Dunn, H. D. California—her agricultural resources. *In* U. S. Comr. Agr. Rpt., 1866, p. 586. 1867.

EARLY BAART.

With the development of drier areas, earlier and more drought-resistant varieties have been desired by growers. Millers have also desired better milling varieties. These demands have been partly met by the use of the Early Baart variety, which also came from Australia. It was received with four other varieties from Australia (S. P. I. Nos. 5075 to 5079,[1] inclusive) by the United States Department of Agriculture in 1900. The commercial distribution of the variety in this country certainly is the result of this introduction. In Australia it has never been a leading commercial variety, although it has been grown by some farmers for many years. It is one of the few varieties grown there which is not of Australian origin. In recent introductions of wheat from South Africa, varieties have been obtained which are identical with Early Baart. The name "Baart" is Dutch for bearded. It seems probable that the variety was introduced into Australia from the Orange River Colony or the Transvaal in South Africa and was originally of European origin.

The Early Baart wheat first became commercially established in Arizona, but by 1914 it had been grown in Washington and soon spread to Idaho and Oregon. A considerable portion of the Early Baart wheat grown in Oregon is from seed distributed from the Sherman County Branch Station, Moro, Oreg. In the year 1919 Early Baart wheat became established in California when a milling company [2] distributed approximately 6,000 tons of seed from Arizona and Washington, or about enough for sowing 175,000 acres. This distribution was made largely for the purpose of improving the milling quality of California wheat.

OTHER VARIETIES.

Many other varieties of Australian wheat have been introduced by the United States Department of Agriculture and other organizations, and most of them have been grown in experiments in the Pacific coast area. In 1904 the Department obtained five varieties (C. I. Nos. 2824 to 2828) from Mr. William Farrer, plant breeder, of New South Wales, Australia. One of these, the Bobs variety (C. I. No. 2826), has been grown in the cooperative experiments at the Sherman County Branch Station at Moro since 1911, and a pure-line selection has been grown in the plat experiments there since 1914. The next lot of Australian varieties was obtained by the Department in 1905 and consisted of four varieties (C. I. Nos. 2829 to 2832; S. P. I. Nos. 12883 to 12886) exhibited by New Zealand at the Louisiana Purchase Exposition. Apparently none of these varie-

[1] Accession numbers of the Office of Foreign Seed and Plant Introduction of the Bureau of Plant Industry, U. S. Department of Agriculture.

[2] Jones, Robert E. Wheat from the antipodes. *In* Country Gent., v. 84, no. 39, p. 11, 26. 1919.
Hodges, R. E. Early Baart ewhat has made good. *In* Pacific Rural Press, v. 98, no. 20, p. 1. 1919.

ties was ever grown in the Pacific coast area. In 1907 five Australian varieties (C. I. Nos. 2990 to 2994; S. P. I. Nos. 21372 to 21376) were presented to the Department by Mr. G. Maurice McKeown, manager of the Wagga Experiment Farm at Bomen, New South Wales. Of these the Silver King, Hudson's Purple Straw, and Farmers Friend have been included in plat experiments at the Plant Introduction Station at Chico, Calif. The California Agricultural Experiment Station obtained the Cumberland (C. I. No. 4607), Federation (C. I. No. 4609), Jumbuck (C. I. No. 4608), and Sunset (C. I. No. 6253) varieties direct from Australia and grew them in experiments at Davis, Calif., as early as 1911, later furnishing seed to the United States Department of Agriculture. All of these varieties and the others introduced with Early Baart are listed with the more recent introductions in Table I and brief descriptions given where possible. The yields of all the varieties grown in plats are given in Tables II and III.

RECENT INTRODUCTIONS.

Realizing the advantages which might be obtained from introducing other Australian varieties, the Office of Cereal Investigations of the Bureau of Plant Industry, United States Department of Agriculture, decided to obtain all the Australian varieties of wheat in order to give them a thorough trial in the Pacific coast area. The requests for seed were made through the Office of Foreign Seed and Plant Introduction of the Bureau of Plant Industry in 1913, and several shipments have been obtained. The Seed and Plant Introduction numbers recorded here are all given in the inventories of the office mentioned, and reference can be made to them if desired.

In November, 1913, 11 varieties (C. I. Nos. 4116 to 4126; S. P. I. Nos. 36577 to 36587) were presented to the Department by Mr. George Valder, secretary and director of the department of agriculture at Sydney, New South Wales. In May, 1914, 11 varieties (C. I. Nos. 4164 to 4174; S. P. I. Nos. 38343 to 38353) were obtained from Mr. E. A. Cook, of Perth, West Australia. A second shipment containing 24 varieties (C. I. Nos. 4718 to 4741; S. P. I. Nos. 41064 to 41087) was obtained from Mr. Valder in August, 1915. In March, 1916, Mr. A. E. V. Richardson, agricultural superintendent of the department of agriculture at Melbourne, Victoria, presented the Department with seed of 35 varieties (C. I. Nos. 4979 to 5013; S. P. I. Nos. 42102 to 42136). At the same time a third shipment was received from Mr. Valder, containing 5 varieties (C. I. Nos. 5019 to 5023; S. P. I. Nos. 42205 to 42209) grown at the Cowra Experiment Farm, New South Wales.

In 1915 exhibits of wheat varieties were made by New Zealand and Australia at the Panama-Pacific International Exposition at San

Francisco, Calif. At the close of that exposition in 1916 samples of 32 varieties were obtained by the Bureau of Plant Industry (C. I. Nos. 5062 to 5069, New Zealand exhibit; C. I. Nos. 5117 to 5140, Australian exhibit). Other organizations also obtained samples of these wheats. Several varieties were grown by a milling company at their experiment station near Stockton, Calif. The Bunyip and the Darts Imperial have been increased by them and to a small extent are being grown commercially.

In August, 1917, the Bureau of Plant Industry received a fourth shipment from Mr. Valder containing seed of 10 varieties of wheat (C. I. Nos. 5978 to 5987; S. P. I. Nos. 45142 to 45151), grown in New South Wales, Australia. Prof. W. W. Mackie obtained samples of the Hard Federation and Clarendon from Australia while in Mexico, and upon his return to the United States in 1917 brought small quantities of seed of these varieties with him. In November, 1917, an Australian variety called Aurora (C. I. No. 6135; S. P. I. No. 45566) was obtained with other wheat samples from Paris, France. Finally, in December, 1918, samples of 3 varieties (C. I. Nos. 6219 to 6221; S. P. I. Nos. 46794 to 46796) were received from Mr. Edwin Ashby, Wittunga, Blackwood, South Australia, the last two having been bred and grown by Mr. F. Coleman, of Tuela, Saddleworth, South Australia.

From 1900 to 1919, therefore, the Bureau of Plant Industry obtained 157 samples of wheat varieties from Australia either direct, through the California Agricultural Experiment Station, or from the exhibits of New Zealand and Australian wheats at the Panama-Pacific International Exposition. This collection contains a few samples which are not Australian varieties and also contains many duplications, but at least 92 distinct varieties (85 of which have names) of Australian origin have been obtained, and most of them have been grown in nursery and plat experiments at several experiment stations in the Pacific coast area.

NURSERY EXPERIMENTS WITH AUSTRALIAN WHEATS.

The yields obtained from Australian varieties of wheat grown in nursery experiments at the Sherman County Branch Station, Moro, Oreg., and at the Plant Introduction Station, Chico, Calif., are shown in Table I. The varieties are arranged in the order of their Cereal Investigations numbers, which are in the order of their introduction. Several varieties are included from which yields were not obtained. These were either not sown or the seed was not viable. They are included in order to present a complete record of the wheats introduced. Brief descriptions are given, showing the class to which the variety belongs and the principal characters of the spike, glume, and kernel.

TABLE I.—*Descriptions of 154 introductions of Australian wheats and yields of those grown in nursery experiments at the Sherman County Branch Station, Moro, Oreg., and at the Plant Introduction Station, Chico, Calif., in the years 1917, 1918, and 1919.*

[KEY TO ABBREVIATIONS USED UNDER "DESCRIPTION."—*Class:* C=common, D=durum, Pd=Poulard, Po=Polish, S=spring, Wn=winter. *Spike:* A=awned, Al=awnless. *Glumes:* Bl=black, Br=brown, G=glabrous, Pu=pubescent, W=white. *Kernels:* R=red, W=white.]

Serial No.		Variety.	Description.				Yield per acre (bushels).						
							Sherman County Branch Station.				Plant Introduction Station.		
C.I.	S.P.I.		Class.	Spike.	Glumes.	Kernels.	1917	1918	1919	Average.	1918	1919	Average.
1697	5078	Early Baart	CS	A	G W	W	[a]13.0	[a]17.8	[a]22.4	17.7	.....	.....	.....
1698	5075	Allora	CS	A	G W	R	.....	.....	.....	.....	.....	.....	.....
1699	5077	Canning Downs	CS	.....	.....	W	.....	.....	.....	.....	.....	.....	.....
1702	5076	Steinwedel	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
1746	5079	King's Early	CS	.....	.....	W	.....	.....	.....	.....	.....	.....	.....
2824	.....	Elephant	CS	Al	G W	W	13.0	24.5	16.3	17.9	[b]42.4	18.2	.....
2825	.....	Nonpareil	CS	.....	.....	W	.....	.....	.....	.....	.....	.....	.....
2826	.....	Bobs	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
2827	.....	Cootabah	D	.....	.....	W	.....	.....	.....	.....	.....	.....	.....
2828	.....	.....	Pd	A	Pu W	W	.....	.....	.....	.....	.....	.....	.....
2829	12883	Pearl	CS	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2830	12884	.....	CS	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2831	12885	Hunters	CS	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2832	12886	Tuscan	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
2990	21372	Silver King	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
2991	21373	Hudson's Purple Straw.	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
2992	21374	Farmers Friend	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
2993	21375	Marshall's No. 3	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
2994	21376	White Essex	CS	.....	..... W	W	.....	.....	.....	.....	.....	.....	.....
4116	36577	Bathurst No. 2	CS	Al	G W	W	[c]3.5	.....	.....	.....	32.6	21.2	26.9
4117	36578	Cedar	CS	Al	G W	R	.....	.....	.....	.....	22.3	16.8	19.6
4118	36579	Cleveland	CS	Al	G W	W	.....	.....	.....	.....	26.3	12.0	19.2
4119	36580	Cowra No. 3	CS	Al	G W	W	20.0	24.5	14.1	19.5	29.3	9.3	19.2
4120	36581	Genoa	CS	Al	G W	W	.....	.....	.....	.....	25.7	13.8	19.8
4121	36582	John Brown	CS	Al	G Br	W	14.5	[b]26.0	12.9	17.8	38.3	24.9	31.6
4122	36583	Jonathan	CS	Al	G W	W	15.0	19.0	12.9	15.6	33.5	14.2	23.9
4123	36584	Wagga No. 19	CS	Al	G W	R	13.8	19.5	17.8	17.0	43.7	15.7	29.7
4125	36586	Rymer	CS	Al	G W	W	11.0	12.5	13.6	12.4	38.3	5.9	22.1
4126	36587	Thew	CS	Al	G W	W	15.5	15.5	12.6	14.5	27.2	17.6	22.4
4164	38343	Alpha	CS	Al	G W	W	12.5	16.0	15.7	14.7	35.5	17.2	26.4
4165	38344	Bayah	CS	Al	G Br	W	13.5	18.5	15.4	15.8	37.8	10.9	24.4
4166	38345	Bunyip	CS	Al	G W	W	16.5	19.5	17.1	17.7	33.8	7.8	20.8
4167	38346	Comeback	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
4168	38347	Federation	CS	Al	G Br	W	.....	.....	26.2	.....	38.6	7.8	23.2
4169	38348	Firbank	CS	Al	G W	W	15.0	15.0	16.5	15.5	27.5	19.3	23.4
4170	38349	Florence	CS	Al	G W	W	15.0	15.5	15.4	15.3	34.3	25.4	29.9
4171	38350	Gluyas Early	CS	Al	G Br	W	15.0	18.0	16.1	16.4	22.5	24.4	23.5
4172	38351	Steinwedel	CS	Al	G W	W	12.0	19.0	16.4	15.8	32.1	10.5	21.3
4173	38352	Warren	CW	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
4174	38353	Yandilla King	CS	Al	G W	W	9.0	17.5	21.1	15.9	38.1	8.8	23.5
4607	.....	Cumberland	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
4608	.....	Jumbuck	CS	Al	Pu W	W	.....	.....	.....	.....	.....	.....	.....
4609	.....	Federation	CS	Al	G Br	W	.....	.....	.....	.....	47.1	22.7	34.9
4718	41064	No. 4	CS	Al	G W	W	17.5	17.0	15.0	16.5	22.5	24.3	23.4
4719	41065	No. 9	CS	Al	G W	W	14.0	14.0	19.2	15.7	33.1	20.4	26.8
4720	41066	No. 3	CS	Al	G Br	W	12.0	14.0	12.1	12.7	17.5	26.6	22.1
4721	41067	No. 14	CS	A	G W	W	11.5	17.0	17.1	15.2	36.4	21.7	29.1
4722	41068	No. 8	CS	Al	G W	W	13.5	16.0	25.5	18.3	37.2	25.2	31.2
4723	41069	No. 11	CS	Al	G W	W	10.5	16.0	16.3	14.3	34.0	22.8	28.4
4724	41070	No. 2	CS	Al	G W	W	15.0	17.0	15.7	15.9	27.4	31.7	29.6
4725	41071	Warren	CS	Al	G W	W	13.0	16.0	16.1	15.0	36.9	31.4	34.2
4726	41072	Marster's Perfection	PdS	A	G W	R	.....	.....	.....	.....	29.3	14.4	21.9
4727	41073	Tarragon	CS	Al	G W	W	12.0	15.5	14.7	14.1	39.1	19.0	29.1
4728	41074	Sunset	CS	Al	G W	W	19.5	9.0	23.4	17.3	23.5	16.6	20.1
4729	41075	Jumbuck cross	CS	Al	G W	W	13.5	14.5	16.4	14.8	37.3	16.7	27.0
4730	41076	Canberra	CS	Al	G Br	W	12.0	18.5	21.8	17.4	34.4	30.2	32.3
4731	41077	Bomen	CS	Al	G W	R	.....	.....	.....	.....	43.9	23.6	33.8
4732	41078	Cleveland	CS	Al	G W	W	12.5	15.5	14.2	14.1	30.5	22.9	26.7
4733	41079	Hard Federation	CS	Al	G Br	W	15.0	21.0	25.8	20.6	46.3	29.4	37.9
4734	41080	Federation	CS	Al	G Br	W	14.0	26.0	29.5	23.2	50.7	24.9	37.8
4735	41081	Steinwedel	CS	Al	G W	W	4.0	15.5	21.7	13.7	38.7	16.8	27.8

[a] Average yields of the three highest yielding check rows.
[b] Adjacent to vacant or thin row.
[c] Poor stand.

TABLE I.—*Descriptions of 154 introductions of Australian wheats and yields of those grown in nursery experiments at the Sherman County Branch Station, Moro, Oreg., and at the Plant Introduction Station, Chico, Calif., in the years 1917, 1918, and 1919*—Continued.

Serial No.		Variety.	Description.				Yield per acre (bushels).						
							Sherman County Branch Station.				Plant Introduction Station.		
C. I.	S. P. I.		Class.	Spike.	Glumes.	Kernels.	1917	1918	1919	Average.	1918	1919	Average.
4733	41082	Purple Straw	CS	Al	G W	W	13.0	14.5	21.2	16.2	35.8	17.1	26.5
4737	41083	Cedar	CS	Al	G W	R	9.5	18.0	17.5	15.0	23.9	11.6	17.8
4738	41084	Cowra No. 16	DS	Al	G Br	W	13.5	20.0	16.8	16.4	19.2	10.2	14.7
4739	41085	Jonathan	CS	Al	G W	W	11.0	16.5	17.1	14.9	23.5	12.7	18.1
4740	41086	Florence	CS	Al	G W	W	.....	.....	.....	.....	29.9	17.3	23.6
4741	41087	Thew	CS	Al	G W	W	7.0	15.0	18.5	13.5	25.1	20.3	22.7
4979	42102	Federation	CS	Al	G Br	W	19.0	21.0	25.6	21.9	46.4	17.5	32.0
4980	42103	Hard Federation	CS	Al	G Br	W	15.5	22.5	27.5	21.8	36.7	25.1	30.9
4981	42104	White Federation	CS	Al	G W	W	21.0	21.0	24.7	22.2	34.4	28.1	31.3
4982	42105	Currawa	CS	Al	G W	W	18.5	20.5	22.7	20.6	33.1	7.9	20.5
4983	42106	Commonwealth	CS	Al	G Br	W	19.5	22.0	19.6	20.4	44.5	19.4	32.0
4984	42107	Major	CS	Al	G W	W	24.0	21.5	22.2	22.6	41.9	26.6	34.3
4985	42108	Nardoo	CS	Al	G W	W	19.5	15.0	19.0	17.8	22.8	16.8	19.8
4986	42109	Canberra	CS	Al	G Br	W	23.0	17.0	22.4	20.8	39.0	30.2	34.6
4987	42110	Crossbred 28	CS	Al	G W	W	18.5	15.5	20.8	18.3	33.8	19.8	26.8
4988	42111	Florence	CS	Al	G W	W	16.0	17.5	25.1	19.5	27.4	25.7	26.6
4989	42112	Cedar	CS	Al	G W	R	24.0	16.0	16.4	18.8	24.7	9.6	17.2
4990	42113	Bobs	CS	Al	G W	W	25.0	16.5	22.2	21.2	31.4	25.3	28.4
4991	42114	Comeback	CS	Al	G W	W	20.0	14.5	17.2	17.2	29.1	29.3	29.2
4992	42115	Huguenot	D	Al	G Bl	W	9.5	12.0	15.0	12.2	26.5	15.7	21.1
4993	42116	Penny	CS	Al	G W	W	22.0	16.5	18.3	18.9	50.1	17.9	34.0
4994	42117	Warden	CS	Al	G W	W	18.5	13.5	16.7	16.2	45.7	22.6	34.2
4995	42118	Marshall No. 3	CS	Al	G W	W	15.0	17.5	19.9	17.5	38.0	13.7	25.9
4996	42119	Dart's Imperial	CS	Al	G W	W	18.5	16.0	21.0	18.5	41.0	26.6	33.8
4997	42120	Yandilla King	CS	Al	G W	W	11.5	14.0	22.0	15.8	43.4	26.5	35.0
4998	42121	College Eclipse	CS	Al	G Br	W	15.0	17.0	19.8	17.3	22.5	27.5	25.0
4999	42122	Correll's No. 3	CS	Al	G Br	W	17.5	15.5	21.4	18.1	31.8	20.3	26.1
5000	42123	Avoca	CS	Al	G W	W	19.5	16.0	18.4	18.0	28.6	25.9	27.3
5001	42124	Wallace	CS	Al	G W	W	12.0	11.0	17.9	13.6	40.3	20.3	30.3
5002	42126	Thew	CS	Al	G W	W	15.0	16.0	21.0	17.3	40.2	28.2	34.2
5003	42125	Triumph	CS	Al	G W	W	11.0	6.5	13.8	10.4	24.1	19.2	21.7
5004	42127	Purple Straw	CS	Al	G W	W	13.0	15.0	21.7	16.6	41.3	11.4	26.3
5005	42128	College Purple Straw	CS	Al	G W	W	12.0	15.0	20.6	15.9	41.6	21.2	31.4
5006	42129	Gluyas	CS	A	G Br	W	19.0	17.0	20.5	18.8	37.1	17.2	27.2
5007	42130	Gamma	CS	Al	G Br	W	11.5	13.5	20.5	15.2	36.7	10.3	23.5
5008	42131	Bayah	CS	Al	G Br	W	17.5	17.5	19.5	18.2	32.4	19.7	26.1
5009	42132	Viking	CS	Al	G Br	W	15.0	14.5	26.2	18.6	39.1	24.2	31.7
5010	42133	White Tuscan	CS	Al	G W	W	12.5	15.5	20.2	16.1	43.0	17.0	30.0
5011	42134	Zealand Blue	CS	Al	Pu W	W	11.5	13.5	15.2	13.4	33.1	12.0	22.6
5012	42135	Bunyip	CS	Al	G W	W	13.0	20.5	24.8	19.4	19.2	25.4	22.3
5013	42136	Firbank	CS	Al	G W	W	22.5	17.0	24.0	21.2	[a]37.0	[a]34.5	.....
5019	42205	Galland's Hybrid	PdW	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
5020	42206	Nevertire	D	Al	Pu W	W	4.5	8.0	7.7	6.7	16.9	5.0	11.0
5021	42207	Blout's Lambrigg	CS	Al	G W	W	18.5	18.0	17.3	17.9	40.2	3.2	21.7
5022	42208	Nyngan	CS	Al	G W	W	[a]37.0	21.5	18.9	[b]20.2	[a]37.4	28.4	.....
5023	42209	Polish	Po	A	G W	W	.....	.....	.....	.....	.....	.....	.....
5062	.....	Bobs	CS	Al	G W	W	.....	.....	.....	.....	[a].5	.....	.....
5063	.....	Bordier	CS	Al	G W	W	6.0	24.0	17.6	15.9	[a]56.6	18.5	.....
5064	.....	Marshall White	CS	Al	G W	W	.....	.....	.....	.....	10.5	10.2	10.4
5065	.....	Pearl	CS	Al	Pu W	W	.....	.....	.....	.....	.....	.....	.....
5066	.....	Velvet Ear	CS	.....	.....	W	.....	.....	.....	.....	.....	.....	.....
5067	.....	Purple-Straw Tuscan	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
5068	.....	Red Chaff	.....	.....	.....	W	.....	.....	.....	.....	[c]5.4	8.5	.....
5069	.....	White-Straw Tuscan	CS	Al	G W	W	13.5	15.0	17.3	15.3	[a]63.4	11.9	.....
5117	.....	Petatz Surprise	CS	Al	G W	W	.....	.....	.....	.....	20.7	24.9	22.8
5118	.....	Federation	CS	Al	G Br	W	.....	.....	27.9	.....	24.8	20.2	22.5
5119	.....	Gluyas	CS	A	G Br	W	.....	.....	.....	.....	31.5	24.5	28.0
5120	.....	Viking	CS	Al	G Br	W	5.5	24.0	24.1	17.9	46.4	29.2	37.8
5121	.....	"Turkey Red"	CS	Al	G W	W	16.0	17.5	18.1	17.2	24.2	17.6	20.9
5122	.....	Huguenot	D	Al	G Bl	W	6.5	12.0	18.9	12.5	15.1	19.6	17.4
5123	.....	Cleveland	CS	Al	G W	W	12.5	24.0	17.0	17.8	[a]47.4	20.1	.....
5124	.....	Bobs	CS	Al	G W	W	.....	.....	.....	.....	c.5	.....	.....
5125	.....	Bunyip	CS	Al	G W	W	.....	.....	.....	.....	c 7.6	22.1	.....
5126	.....	Steinwedel	CS	Al	G W	W	6.0	23.5	19.4	16.3	[a]65.4	21.7	.....
5127	.....	Yandilla King	CS	Al	G W	W	.....	.....	.....	.....	[a]46.5	21.4	.....
5128	.....	Dart's Imperial	CS	Al	G W	W	.....	.....	.....	.....	c 1.6	.....	.....
5129	.....	Florence	CS	Al	G W	W	.....	.....	.....	.....	[a]55.4	14.7	.....
5130	.....	John Brown	CS	Al	G Br	W	6.5	24.0	16.5	15.7	[a]47.1	10.0	.....

[a] Adjacent to vacant or thin row. [b] Average for 1918 and 1919. [c] Poor stand.

TABLE I.—*Descriptions of 154 introductions of Australian wheats and yields of those grown in nursery experiments at the Sherman County Branch Station, Moro, Oreg., and at the Plant Introduction Station, Chico, Calif., in the years 1917, 1918, and 1919*—Continued.

Serial No.		Variety.	Description.				Yield per acre (bushels).						
							Sherman County Branch Station.				Plant Introduction Station.		
C. I.	S. P. I.		Class.	Spike.	Glumes.	Kernels.	1917	1918	1919	Average.	1918	1919	Average.
5131	.....	Haynes Bluestem...	CS	.....	.....	R	.....	.....	.....	.....	.....	.....	.....
5132	.....	Thew.....	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
5133	.....	Cedar.....	CS	Al	G W	R	.....	.....	.....	.....	[a] 1.2	.....	.....
5134	.....	American No. 8.....	CS	Al	G W	R	25.0	[b]33.0	17.8	[c]21.4	[b]46.0	24.7	.....
5135	.....	Marshall's No. 3.....	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
5136	.....	Indian Runner.....	D	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5137	.....	Warren.....	CS	Al	G W	W	.....	.....	.....	.....	[a] 5.4	14.4	.....
5138	.....	Bayah.....	CS	Al	G Br	W	.....	.....	.....	.....	[a] 8.5	20.0	.....
5139	.....	King's Early.....	CS	A	G W	W	9.5	[c]36.5	20.1	[c]14.8	[b]58.6	20.0	.....
5140	.....	Medeah.....	D	A	G W	W	.....	.....	.....	.....	.....	.....	.....
5978	45142	Bunyip.....	CS	Al	G W	W	.....	.....	.....	.....	[a].6	.....	.....
5979	45143	Comeback.....	CS	Al	G W	W	.....	.....	.....	.....	[b]28.0	17.0	.....
5980	45144	Firbank.....	CS	Al	G W	W	.....	.....	.....	.....	14.2	17.8	16.0
5981	45145	Florence.....	CS	Al	G W	W	.....	.....	.....	.....	26.9	23.6	25.4
5982	45146	Marshall's No. 3.....	CS	Al	G W	W	.....	.....	.....	.....	[a] 5.0	12.6	.....
5983	45147	Rymer.....	CS	Al	G W	W	.....	.....	.....	.....	[b]25.2	11.2	.....
5984	45148	Sunset.....	CS	Al	G W	W	.....	.....	.....	.....	[b]36.0	17.3	.....
5985	45149	Warren.....	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
5986	45150	Yandilla King.....	CS	Al	G W	W	.....	.....	.....	.....	[a].5	.....	.....
5987	45151	Zealand.....	CS	Al	Pu W	W	.....	.....	.....	.....	[b]42.0	7.4	.....
6135	45566	Aurora.....	CS	Al	G Br	R	.....	.....	.....	.....	.....	.....	.....
6219	46794	Federation.....	CS	Al	G Br	W	.....	.....	.....	.....	.....	.....	.....
6220	46795	Boadicea.....	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
6221	46796	Onas.....	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....
6253	.....	Sunset.....	CS	Al	G W	W	.....	.....	.....	.....	.....	.....	.....

[a] Poor stand. [b] Adjacent to vacant or thin rows. [c] Average for 1917 and 1918.

RESULTS AT MORO.

The Sherman County Branch Station is located in Sherman County, Oreg., on the rolling hills of the Columbia Basin, at an altitude of 1,800 feet. The soil is a fine silt loam, classed as Yakima silt loam. It is characteristic of a large portion of the Columbia Basin. The average annual precipitation during the 14 years from 1905 to 1919 was only 11.58 inches. The distribution of the precipitation, however, usually is favorable for wheat production, nearly all the rain falling during the months from September to June. July and August are practically rainless. Alternate cropping and summer fallowing is the common practice for wheat production.

In Table I the yields at Moro are computed from single 16-foot rows in 1917 and 1918 and from triplicate 32-foot rows in 1919.

Of the Australian wheats grown at Moro, 11 varieties exceeded 20 bushels per acre in average yield during the 3-year period from 1917 to 1919, inclusive. All three Federation wheats (Federation, Hard Federation, and White Federation) are in this group, Federation, C. I. No. 4734, leading, with an average yield of 23.2 bushels. The yields of the single-rod rows in 1917 and 1918 may not be very important. In 1919 the experiment was on very uniform ground, a good stand of all varieties was obtained, and it is believed that the com-

parison was as accurate as is possible with grain varieties in rows. It will be noted from Table I that the Federation group of wheats with one exception exceeded 25 bushels per acre in yield. Only 3 other varieties (No. 8, C. I. No. 4722; Florence, C. I. No. 4988; and Viking, C. I. No. 5009) exceeded 25 bushels per acre, and only 24 varieties other than the Federation wheats exceeded 20 bushels in acre yield in 1919. Federation, C. I. No. 4734, exceeded the average yield of the three highest yielding check rows of Early Baart by 7.2 bushels per acre in 1919 and exceeded the yield of the highest yielding check row of Early Baart by 6.5 bushels.

RESULTS AT CHICO.

The Plant Introduction Station is located in Butte County, Calif., in the Sacramento Valley, at an altitude of 189 feet. The soil is a sandy loam containing some gravel. Shallow spots, with outcropping lava rock, are common. Although not uniform, the soil is characteristic of a large portion of the wheat land of the Sacramento Valley, the best being used for fruit growing. The normal annual precipitation is 23.6 inches, most of it occurring from September to May. The wheat experiments have been conducted without irrigation, but either on summer fallowed land or following a crop of alfalfa or corn.

At Chico the yields are computed from duplicate 16-foot rows in 1918 and from triplicate 16-foot rows in 1919. (Table I.) The average results for the two years show that 23 varieties exceeded 30 bushels per acre in average yield. Hard Federation (C. I. No. 4733) was the highest yielding variety, averaging 37.9 bushels per acre. With but one exception (C. I. No. 4168), all strains of the Federation group were among the 23 highest yielding varieties. Of the other wheats, Viking (C. I. No. 5120) and Yandilla King (C. I. No. 4997) produced the highest yields, averaging 37.8 and 35 bushels per acre, respectively.

In 1918 soil conditions were fairly uniform and good stands were secured except in a few cases where the seed was not viable or where only small quantities of seed were available. The highest yielding varieties (rows adjacent to vacant or thin rows not included) were those of the Federation group.

In 1919 good uniform stands were secured. The soil conditions were fairly uniform except on one corner of the nursery, where a part of a replicated series was not harvested. Rainy weather in winter and early spring produced a heavy plant growth with conditions favorable for the spread of an infection of powdery mildew (*Erysiphe graminis*), which resulted in the lodging of practically 100 per cent of the crop in nearly all varieties. Yields consequently were reduced. Firbank (C. I. No. 5013) was the leading variety, with Hard Federation (C. I. No. 4733) ranking fourth.

FEDERATION GROUP OF UNUSUAL PROMISE.

These preliminary nursery experiments show that several of the Australian varieties may be well adapted for growing in the Pacific coast area of the United States. After observing the varieties during four seasons, the Federation group, including the three varieties, Federation, Hard Federation, and White Federation, appears to the writer to be the most promising. They are all early maturing, have strong, stiff straw, do not shatter easily, and the yields have been outstandingly high.

The unusual promise of these varieties was first observed at the Sherman County Branch Station at Moro, Oreg., in 1916, when grown in 5-foot head rows. As a result, increase rows were sown in the season of 1917. Sufficient seed was secured for sowing Federation (C. I. No. 4734) and Hard Federation (C. I. No. 4733) in plats in the spring of 1918. A small quantity of the seed of Hard Federation (C. I. No. 4980) and White Federation (C. I. No. 4981) was sent to the Plant Introduction Station at Chico, Calif., for sowing in the fall of 1917. In the fall of 1918 seed of Federation (C. I. No. 4734) was sent to Chico for sowing and in the spring of 1919 seed of White Federation (C. I. No. 4981) was returned to Moro.

Before giving the agronomic results obtained from these experiments the history and a description of each of the varieties in the Federation group will be given.

FEDERATION.

History.—The history of Federation wheat here given is that recorded by Richardson,[1] and the quotation also shows the popularity of the variety in Australia.

> This is, without question, the most popular and prolific variety of wheat in general cultivation at the present day. It was produced by the late Mr. Farrer, wheat experimentalist, of New South Wales, from a cross between Purple Straw and Yandilla. Yandilla is a cross between Improved Fife and Etewah, an Indian variety. The production of this wheat was probably the greatest of Mr. Farrer's many triumphs in wheat breeding, for none of his many successful crossbred wheats have enjoyed such a wide measure of popularity as Federation. Indeed, during the last six years the golden yellow characteristic of old-time Australian harvest fields has been gradually changed to a dull bronze through the ever-increasing popularity of Federation wheat.

The Federation wheat became commercially established in Australia from 1908 to 1912 and since that time has occupied about 80 per cent of the dry-land wheat area of that country. It has also recently become commercially established in India.[2]

Description.—Plant spring habit, early, short; straw white, strong; spike awnless, oblong, dense, erect; glumes glabrous, brown, short, wide; shoulders wide, oblique

[1] Richardson, A. E. V. Wheat and its cultivation. Dept. Agr., Victoria, Aust. Bul. 22, n. s., p. 124–126. [1913.] Reprinted from Jour. Dept. Agr., Victoria, v. 10–11. 1912–13.

[2] Australian wheat successfully grown in India. *In* Jour. Dept. Agr., Victoria, v. 17, pt. 10. p. 635–636. 1919.

to square; beaks narrow, acute, 0.5 mm. long; apical awns usually wanting; kernels white, small to midsized, soft, ovate, broad; germ midsized; crease usually narrow, shallow; cheeks rounding; brush midlong.

HARD FEDERATION.

History.—In consequence of the variations of the ordinary type exhibited by the strain of Federation wheat now being grown at Cowra Experiment Farm, it has been deemed advisable to apply a distinct name to it, and "Hard Federation" has been selected as the most appropriate. . . . The departure from type was first noticed by Mr. J. T. Pridham, plant breeder, in 1907 or 1908, one of the plants selected from the stud plats being observed to thrash grain of remarkably hard and flinty appearance. The plant has the distinctive brown, hard, and general appearance of Federation in the field, but the grain was of a class that has never been seen in the variety before. (Agricultural Gazette, New South Wales, v. 25, p. 664. 1914.)

The Hard Federation variety has been grown commercially in Australia since 1914. During the past few years it has replaced the Federation variety in many sections because of equal yields and better milling quality of the grain.

Description.—Plant spring habit, early, short; straw white, strong; spike awnless, oblong, dense, erect; glumes glabrous, brown, short, wide; shoulders wide, square; beaks narrow, acute, 0.5 mm. long; apical awns wanting; kernels white, small, hard, ovate, with truncate tip; germ midsized, wide; crease midwide, middeep, frequently pitted; cheeks rounding; brush midlong.

The variety differs principally from Federation in being slightly taller and earlier, in having a square and shorter spike, broader and squarer shoulders, and shorter, rounder, and harder kernels. The small hard or vitreous kernels are very attractive and doubtless would attract buyers and bring a premium over other white wheats on American markets, as is the case in Australia. Heads of Hard Federation, White Australian, and Early Baart wheats are shown in Plate II, figure 1, and kernels in Plate I, figure 2, and in Plate II.

WHITE FEDERATION.

History.—As far as the authors are aware the history of the White Federation variety has never been recorded in Australian literature. The following sentence, however, indicates its origin:

The seed [hard kernels selected from Federation by Mr. J. T. Pridham, from which Hard Federation originated] was propagated, and in 1910 the occurrence of white heads was noticed, and from then until 1912 distinctly white heads were common among the brown. (Agricultural Gazette, New South Wales, v. 25, p. 664. 1914.)

The name White Federation has been used for this wheat at the Cowra Experiment Farm since 1915, when a field of 3 acres of the variety was grown. (Agricultural Gazette, N. S. W., v. 27, pp. 231 and 469. 1916.)

Description.—Plant spring habit, early, short to midtall; straw white, strong; spike awnless, oblong, middense, erect; glumes glabrous, white, short, wide, thick; shoulders wide, square; beaks narrow, acute, 0.5 mm. long; apical awns wanting or nearly so; kernels white, small, hard to semihard, ovate, with truncate tip; germ midsized, wide; crease midwide, middeep; cheeks rounding; brush midlong.

This variety differs from Hard Federation principally in having white instead of brown glumes, in being slightly taller, in having firmer glumes, thus being less easily shattered, and in having slightly softer kernels and possibly a greater capacity for yield under favorable conditions.

PLAT EXPERIMENTS.

The Hard Federation variety has been grown in plats at Moro, Oreg., and Chico, Calif., during two years, 1918 and 1919. The Federation was grown at Moro in 1918 and 1919, and White Federation only in 1919. White Federation was grown at Chico in 1918 and 1919, but Federation only in 1919. Other Australian varieties have been grown at both stations for longer periods. The principal results obtained in these experiments, with commercial varieties included for comparison, are given in Tables II to V.

RESULTS AT MORO.

In the Columbia Basin of Oregon the principal spring wheat varieties are Early Baart, Pacific Bluestem, and Marquis. The latter is a hard red wheat. The principal winter varieties in the drier parts of this section are Turkey and Kharkof, which are similar hard red wheats, and Fortyfold, which is a soft white wheat. All of these have been grown in the plat experiments at the Sherman County Branch Station. Of these, Early Baart and Pacific Bluestem are of Australian origin. The Bobs, another Australian variety, has been grown in plats since 1914. The annual and average yields of these varieties are shown in Table II, with a percentage comparison for the same station years, using the yield of Pacific Bluestem as 100 per cent.

TABLE II.— *Yield of three varieties of Australian and four other important varieties of wheat compared with Pacific Bluestem as grown in the plat experiments at the Sherman County Branch Station, Moro, Oreg., during the 9-year period from 1911 to 1919, inclusive.*

[The three Australian varieties are each designated by an asterisk (*).]

Variety.		Yield per acre (bushels).											Percentage of Pacific Bluestem.
											Average.		
Class and name.	C. I. No.	1911	1912	1913	1914	1915	1916	1917	1918	1919	1911 to 1919	Pacific Bluestem comparison.	
Spring wheat:													
*Pacific Bluestem	4067	11.7	20.2	19.4	20.9	24.0	37.3	17.5	13.0	23.7	20.9	.....	100
*Early Baart	1697	14.5	19.0	25.0	26.0	26.6	40.9	19.4	14.9	24.2	23.3	+2.5±0.5	112.1
*Bobs	2826–1	.....	.....	.....	24.7	25.4	45.5	23.3	18.5	26.3	.....	+4.6±0.7	120.1
Marquis	4158	.....	.....	22.1	22.5	23.1	37.0	20.8	15.0	22.7	.....	+1.2±0.5	104.7
Winter wheat:													
Kharkof	1442	6.3	27.6	[a]24.0	24.0	21.3	52.3	24.3	[b]26.2	[b]40.0	27.3	+6.5±1.7	131
Turkey (local)	4429	9.0	14.2	[a]24.0	22.5	21.3	50.8	22.3	27.3	36.6	25.3	+4.5±1.8	121
Fortyfold	4156	3.4	17.5	21.6	19.7	26.5	38.0	21.8	25.9	26.2	22.2	+1.4±1.1	106

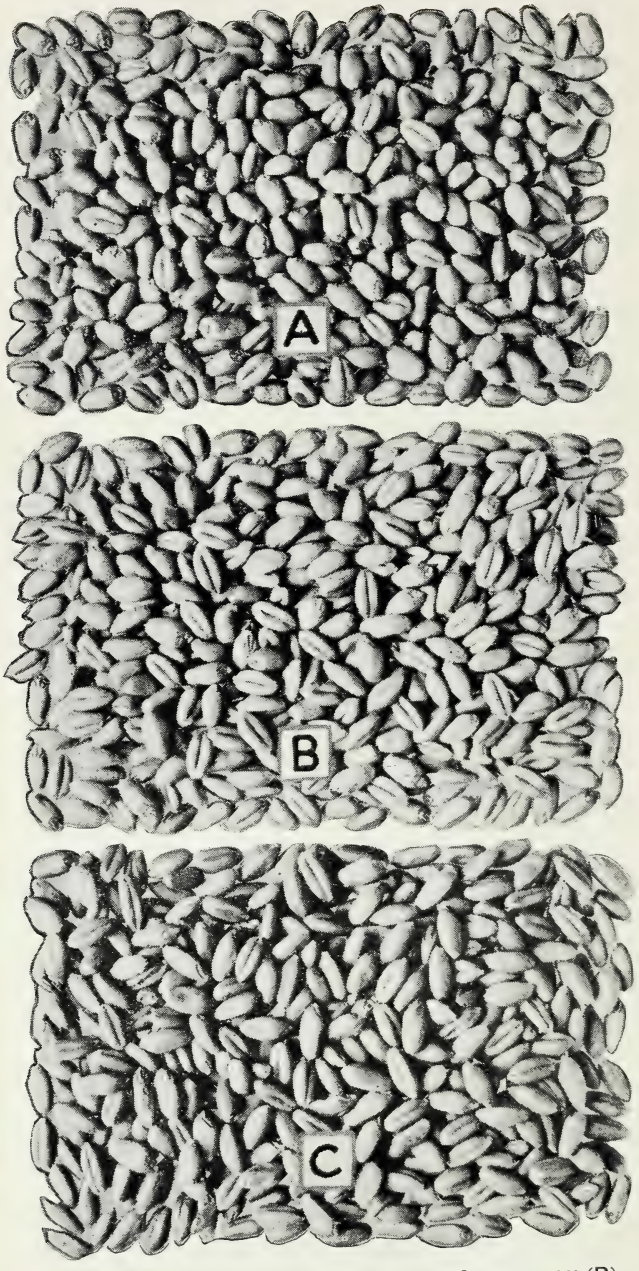
[a] Yield of Turkey, C. I. No. 1558, substituted.
[b] Yield of Selection No. 12 from Kharkof, C. I. No. 1442, substituted.

FIG. 1.—HEADS OF HARD FEDERATION (A), WHITE AUSTRALIAN (B), AND EARLY BAART (C) WHEATS.

All one-half natural size.

FIG. 2.—KERNELS OF HARD FEDERATION (A), WHITE AUSTRALIAN (B), AND EARLY BAART (C) WHEATS.

Magnified one and one-half diameters.



GRAIN OF HARD FEDERATION (A), WHITE AUSTRALIAN (B), AND EARLY BAART (C) WHEATS.

Natural size.

In some years, spring wheat will yield as well as fall-sown wheat at Moro. On the average, however, fall wheat is more successful. The Turkey is the most widely grown fall-sown variety in the vicinity of Moro. The Kharkof is increasing in acreage because it has yielded somewhat better, and Fortyfold is preferred by some growers in localities of high elevation. Of the spring wheats, Pacific Bluestem was formerly the principal variety grown. During the past six years, however, it has been largely replaced by Early Baart and to a small extent by Marquis. Table II shows that commercial practices are in accordance with the results of experiments at Moro. During the 9-year period from 1911 to 1919, inclusive, Kharkof has yielded at the rate of 27.3 bushels per acre, outyielding Pacific Bluestem by 6.5 bushels, a significant difference of 31 per cent. The Turkey has yielded somewhat less than Kharkof, but still 21 per cent more than the Pacific Bluestem, while Fortyfold has yielded only 6 per cent more. In the same period, Early Baart has exceeded the yield of Pacific Bluestem by 2.4 bushels, or a significant difference of 12.1 per cent. In the seven years from 1913 to 1919, inclusive, Marquis has exceeded the yield of Pacific Bluestem by only 4.7 per cent. In the six years from 1914 to 1919, inclusive, Bobs has outyielded Pacific Bluestem by a significant amount (4.6 bushels, or 20.1 per cent). This variety of Australian wheat has a hard, white kernel, and milling results on grain grown at Moro during a series of years have shown it to be an exceptionally good milling and bread-making wheat, comparing favorably with Marquis in every respect. The commercial distribution of the Bobs variety has been withheld only because of even more promising results obtained from the Federation group of Australian wheats.

The principal agronomic results obtained in plat experiments with Federation, Hard Federation, White Federation, and several commercial wheats at Moro in 1918 and 1919 are given in Table III.

TABLE III.—*Agronomic data obtained from eight varieties of wheat grown in plats at the Sherman County Branch Station, Moro, Oreg., in 1918 and 1919.*

Variety.		Crop of 1918.				Crop of 1919.			
Class and name.	C. I. No.	Stand.	Maturity from emergence.	Height.	Yield per acre.	Stand.	Maturity from emergence.	Height.	Yield per acre.
Spring wheat: [a]		*P. ct.*	*Days.*	*Inches.*	*Bushels.*	*P. ct.*	*Days.*	*Inches.*	*Bushels.*
Hard Federation	4733	90	89	23	21.3±0.8	85	101	25	28.7±3.1
Federation	4734	90	98	23	21.0± .6	90	106	25	28.7±2.8
White Federation	4981					75	103	26	28.3
Marquis	4158	95	97	24	15.0±1.7	80	109	28	22.7±0.8
Early Baart	1697	80	94	24	14.9± .3	75	108	29	24.2±2.1
Pacific Bluestem	4067	85	95	24	13.0± .8	90	111	29	23.7±1.1
Winter wheat: [b]									
Kharkof	1442–12	85	197	29	26.2±1.1	100	267	33	40.0±2.0
Fortyfold	5290	90	197	34	25.9±1.0	90	270	34	26.2±1.6

[a] Twentieth-acre plats replicated twice. [b] Twentieth-acre plats replicated 3 times.

The Hard Federation (C. I. No. 4733) was the highest yielding variety of spring wheat grown at the Sherman County Branch Station in 1918. It outyielded Federation (C. I. No. 4734) by only 0.3 bushel, but it outyielded both the Marquis and Early Baart varieties by more than 6 bushels and Pacific Bluestem by more than 7 bushels per acre. Both Hard Federation and Federation were outyielded by Kharkof and Fortyfold winter wheats.

In 1919 Hard Federation, Federation, and White Federation outyielded all other varieties of spring wheat, but again did not yield as well as fall-sown varieties. Hard Federation and Federation were equal, yielding 28.7 bushels per acre, and White Federation yielded only 0.2 bushel less. These yields are more than 4 bushels greater than those obtained from Early Baart and Pacific Bluestem and nearly 6 bushels greater than the yield of Marquis. For the two years 1918 and 1919, Hard Federation had an average yield of 25 bushels per acre, or 5.4 bushels more than Early Baart, 6.1 bushels more than Marquis, and 6.6 bushels more than Pacific Bluestem. Federation had an average yield of only 0.1 bushel less than Hard Federation. They have yielded about 8 bushels less than Kharkof winter wheat, but only about 1 bushel less than Fortyfold. The average difference between the yields of Pacific Bluestem and those of Hard Federation and Federation are 6.7 ± 1.4 and 6.5 ± 1.3 bushels, respectively. These are significant differences and represent an increase in yield of 36.6 and 35.8 per cent.

Both the Hard Federation and Federation varieties have an average height of 24 inches, which is $2\frac{1}{2}$ inches shorter than Early Baart and Pacific Bluestem, 7 inches shorter than Kharkof, and 10 inches shorter than Fortyfold. Hard Federation has matured in 95 days from emergence and in the two years was six days earlier than Early Baart and eight days earlier than Marquis and Pacific Bluestem. Federation was seven days later than Hard Federation.

RESULTS AT CHICO.

In the Sacramento Valley of California the White Australian is the principal commercial variety. A considerable acreage of Early Baart wheat was grown for the first time in 1919. The Sonora variety, important in other sections of California, is grown only to a very small extent, as are also Turkey and Marquis. Although these latter varieties, especially the red-kerneled wheats, are not generally grown, they are included here for comparison. In addition to White Australian and Early Baart, the principal commercial varieties, several other Australian wheats have been grown in the varietal experiments at the Plant Introduction Station at Chico. The annual and average yields obtained from these wheats are shown in Table IV.

TABLE IV.— *Yields of nine varieties of Australian and three other important varieties of wheat compared with the White Australian variety, as grown in plat experiments at the Plant Introduction Station, Chico, Calif., during the 10-year period from 1910 to 1919, inclusive.*

Variety.		Yield per acre (bushels).										Average.		Percentage of White Australian.
Class and name.	C. I. No.	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1910 to 1919	White Australian comparison.	
Australian:														
White Australian	3019	28.0	65.5	31.5	44.7	34.7	18.6	32.0	43.9	22.6	32.1	35.4	.....	100.0
Early Baart	1697	39.3	90.6	27.5	45.7	30.2	19.2	27.5	47.8	19.7	22.9	37.0	+1.7±2.0	104.7
Allora	1698	36.2	67.6	30.0	40.2	32.0	17.0	28.8	.....	.....	.....	.....	− .5±1.1	98.6
Pacific Bluestem	2985	.....	.....	22.5	46.8	35.7	23.2	29.7	41.2	[a]21.1	[a]35.2	.....	− .5±1.1	98.6
Silver King	2990	.....	.....	30.0	43.5	32.5	26.2	28.5	.....	.....	.....	.....	− .2±1.3	99.5
Hudson Purple Straw	2991	.....	.....	30.0	43.2	30.0	21.0	29.3	.....	.....	.....	.....	− .3±1.0	95.2
Farmers Friend	2992	.....	.....	32.5	43.3	28.0	18.7	21.0	.....	.....	.....	.....	−3.2±1.1	88.8
Elephant	2824	.....	.....	31.2	.....	31.5	18.0	.....	.....	.....	.....	.....	−1.4±1.5	95.2
Bobs	2826–1	.....	.....	.....	.....	.....	.....	.....	.....	16.8	28.8	.....	−4.6±1.1	83.3
Other varieties:														
Sonora	3622	[b]32.0	[b]57.3	.....	.....	33.7	22.2	25.9	34.3	18.7	24.2	.....	−4.2±1.4	89.5
Marquis	4158	.....	.....	.....	.....	.....	.....	.....	36.0	30.5	31.0	.....	− .4±3.3	98.5
Kharkof	1442	.....	.....	.....	.....	.....	.....	.....	37.1	25.0	25.4	.....	−3.7±2.4	88.7

[a] Yield of Pacific Bluestem, C. I. No. 4067, substituted.
[b] Yield of Sonora, C. I. No. 1743, substituted.

During the 10-year period from 1910 to 1919 White Australian yielded at the rate of 35.4 bushels per acre. In the same period Early Baart had an average yield of 37 bushels. The increase over White Australian is due to the abnormal yield in 1911 of 90.6 bushels. The average difference of 1.7 ± 2 bushels, representing 4.7 per cent, is not a significant increase. On the other hand, no other Australian or commercial variety shown in Table IV outyielded White Australian. Five Australian varieties were grown for three to seven years and were discarded because they did not yield as well as White Australian. Pacific Bluestem, during the eight years 1912 to 1919, inclusive, yielded a half bushel less. During the two years, 1918 and 1919, the Bobs variety, which yielded well at Moro, Oreg., had a yield significantly less than White Australian. This is also true of the Sonora variety during an 8-year period. The red wheats, both Marquis and Kharkof, also have yielded less than White Australian. The farm practice in the Sacramento Valley of growing White Australian as the principal commercial variety and the introduction of Early Baart are in accord with the experiments at the Plant Introduction Station. The better milling quality of Early Baart as compared with the White Australian variety was a sufficient reason for establishing the former variety commercially, even though the two varieties were only equal in yield. This would have been attempted several years before had it not been for the rather weak straw of the Early Baart variety and its tendency to lodge when grown on heavy or well-fertilized soil and under a heavy rainfall.

Also, if allowed to stand after it is fully ripe, Early Baart shatters more than does White Australian. These two factors may limit the further distribution of Early Baart wheat in California.

The agronomic data obtained from growing Federation, Hard Federation, and White Federation in comparison with commercial wheats at Chico in 1918 and 1919 are presented in Table V.

TABLE V.—*Agronomic data obtained from eight varieties of wheat grown in plats at the Plant Introduction Garden, Chico, Calif., in 1918 and 1919.*

Season and variety.	C. I. No.	Maturity from sowing.	Stand.	Height.	Yield per acre.	
					Straw.	Grain.
Crop of 1918:[a]		*Days.*	*Per cent.*	*Inches.*	*Pounds.*	*Bushels.*
White Federation[b]	4981	198	90	52	7,000	50.0
Hard Federation[b]	4980	198	90	50	6,355	45.1
Marquis	4158	203	91	56	5,420	30.5±0.2
Kharkof	1442	207	90	48	5,180	25.0±2.0
White Australian	3019	205	89	54	6,200	23.6±0.2
Early Baart	1697	201	89	52	6,000	19.7±0.7
Sonora	3622	202	89	47.5	5,030	18.7±1.3
Crop of 1919:[c]						
Federation[d]	4734	194	85	40	2,975	38.8
White Federation	4981	191	85	46	3,563	36.7±1.7
Hard Federation	4980	191	85	45.5	3,813	34.4±2.2
White Australian	3019	195	88	54	3,138	32.1±1.5
Marquis	4158	196	83	48	2,863	31.0±2.7
Kharkof	1442	198	85	41	2,738	25.4±3.3
Sonora	3622	195	83	46	1,863	24.2±1.8
Early Baart	1697	195	78	49	2,413	22.9±1.9

[a] Plats 0.017-acre replicated 4 times except as noted.
[b] Single 0.0085-acre plat.
[c] Plats 0.02-acre replicated 4 times except as noted.
[d] Single 0.04-acre plat.

In 1918 only enough seed was available for sowing single plats of Hard Federation (C. I. No. 4980) and White Federation (C. I. No. 4981). These results, therefore, are not strictly comparable with those obtained from other varieties, but the exceptionally high yields obtained are striking. The yields from both wheats are about twice those obtained from White Australian and Early Baart, the principal commercial varieties. The Federation outyielded Hard Federation by nearly 5 bushels per acre.

In 1919 Federation (C. I. No. 4734) was included in the experiment, but only one plat was grown. The yield from this plat exceeded the average yield obtained from the four plats of both White Federation and Hard Federation. White Federation outyielded Hard Federation with a difference of 2.3 bushels and outyielded the White Australian variety by 4.6 bushels per acre. Because of a poor stand the yields of Early Baart were reduced by probably 8 to 10 bushels per acre. Comparison with it, therefore, is not possible.

In the two years 1918 and 1919 White Federation had an average yield of 43.4 bushels per acre, Hard Federation producing an average of 3.6 bushels less. They have both outyielded the commercial

wheats by large differences. The average differences between the yields of White Federation and Hard Federation and that of White Australian are 11.0 ± 5.4 and 7.4 ± 4.3 bushels, respectively. Although not significant because of the large experimental error, they represent increases in yield of 59 and 45.9 per cent, respectively.

White Federation has an average height of 49 inches. This is more than 2 inches taller than Sonora, but 1½ inches shorter than Early Baart and 6 inches shorter than White Australian. Hard Federation is about an inch shorter than White Federation. Both varieties have strong, stiff straw and will not shatter as badly as Early Baart if allowed to stand after they are fully ripe. Heads and grain of Hard Federation, White Australian, and Early Baart are shown in Plate I, figures 1 and 2, and in Plate II.

SUMMARY OF YIELDS.

Yields for two years at both Moro, Oreg., and Chico, Calif., indicate that Federation, Hard Federation, and White Federation have a yielding capacity in excess of commercial spring-wheat varieties now grown in these districts. These preliminary results show that Hard Federation is the highest yielding of the three varieties at Moro, while at Chico White Federation has outyielded it. Further experiments are necessary to determine which of the three varieties is the best yielder in each section.

WATER REQUIREMENT.

At Moro, Oreg., an attempt was made in 1919 to determine whether a lower water requirement was a reason for the apparent greater yielding capacity of the Hard Federation as compared with the Early Baart variety. A transpiration experiment was conducted in accordance with the methods used by Briggs and Shantz.[1] The term "water requirement" indicates the ratio of the weight of water absorbed by a plant during its growth to the weight of total dry matter or grain produced. Substantial cans of heavy galvanized corrugated iron were used in the experiment as soil containers for growing the experimental plants. The determination of the quantity of water used by the varieties necessitated the measurement of the amount added to the soil during the growth of the plants and of the difference in the water content of the soil at the beginning and at the end of the experiment. The results obtained from the 1-year experiments are shown in Table VI.

[1] Briggs, L. J., and Shantz, H. L. The water requirement of plants. I.—Investigations in the Great Plains in 1910 and 1911. U. S. Dept. Agr., Bur. Plant Indus. Bul. 284, 49 p., 2 fig., 11 pl. 1913.

TABLE VI.—*Water requirements of Hard Federation and Early Baart varieties of wheat at Moro, Oreg., in 1919.*

Variety and pot number.	Water requirement (pounds) based on—	
	Total crop (pounds).	Grain (pounds).
Early Baart:		
Pot No. 1	550	2,400
Pot No. 2	530	2,225
Pot No. 3	574	2,640
Average	551±9	2,422±87
Hard Federation:		
Pot No. 1	485	1,246
Pot No. 2	550	1,618
Pot No. 3	580	1,789
Average	538±21	1,551±120
Difference	13±23	871±148

The results indicate that there is no difference in the water requirements of the two varieties based on the total crop, but that there is a significant difference in the water requirement based on grain production.

MILLING AND BAKING EXPERIMENTS.

Samples of the varieties of wheat grown at Moro, Oreg., and Chico, Calif., listed in Tables III and V, have been milled and the flour baked in the milling and baking laboratory of the Bureau of Markets, United States Department of Agriculture, at Washington, D. C. Samples grown at Moro in 1919 have been sent to a grain company and milling and baking experiments also have been conducted by them in their laboratory at Portland, Oreg. Samples grown at Chico in 1919 also have been furnished another company. These have been milled and baked in their laboratory at Vallejo, Calif. The results obtained from experiments conducted in cooperation with the Bureau of Markets are given in Tables VII and VIII.

RESULTS FROM SAMPLES GROWN AT MORO.

Until recent years a premium has been paid by millers for Pacific Bluestem wheat grown in the Columbia Basin of Oregon because of its superior milling value over other white wheats. This premium is now paid for grain of Early Baart because it is recognized as a better milling wheat than Pacific Bluestem. Millers also have been active in increasing the acreage of Marquis, a red wheat, in this section that they might obtain a supply of better milling wheat. The Turkey and Kharkof hard red wheats are recognized as the best fall-sown varieties for milling. Fortyfold is considered about the average for milling and bread-making of the white wheats of poorer quality. The results of milling Federation, Hard Federation, and White Federation in comparison with these wheats, from samples grown in 1918 and 1919, are presented in Table VII.

TABLE VII.—*Descriptive data and results of milling and bakingtests of eight varieties of wheat grown at the Sherman County Branch Station, Moro, Oreg., in 1918 and 1919.*

[Data obtained in cooperation with the Bureau of Markets, United States Department of Agriculture.]

DESCRIPTIVE DATA OF WHEAT AND FLOUR.

Season and variety.	C. I. No.	Lab. No.	Grade.[a]	Bushel weight (pounds).		Screenings (per cent).	Composition (per cent).					
							Moisture content.			Crude protein (N × 5.7).		
				Before cleaning.	After cleaning.		Wheat.		Flour.	Wheat.	Flour.	Ash in flour.
							Before tempering.	After tempering.				
Crop of 1918:												
Hard Federation	4733	4746	2 HWh	58.5	59.8	4.4	10.5	15	11.7	15.2	14.3	0.52
Federation	4734	4756	4 HWh	54.6	56.7	7.2	10.3	14	11.7	14.3	12.4	.56
Early Baart	1697	4748	4 HWh	55.1	57.0	7.5	9.7	14	11.3	15.8	14.1	.56
Pacific Bluestem	4067	4757	4 HWh	53.5	56.1	9.1	10.1	14	11.8	15.7	14.0	.58
Fortyfold	5290	4747	3 HWh	57.9	58.1	3.5	10.4	13.8	12.1	13.2	11.7	.54
Kharkof	1442	4760	2 DHWn	59.7	60.0	3.2	10.4	15	11.3	11.4	10.7	.48
Marquis	4158	4751	4 DNS	53.9	55.3	3.6	10.7	15	12.9	16.6	15.7	.56
Crop of 1919:												
Hard Federation	4733	5809	3 HWh	56.5	56.9	1.6	9.6	15	12.5	14.3	13.1	.50
White Federation	4981	5805	3 HWh	57.4	57.4	1.8	9.9	15	12.4	13.3	12.3	.48
Federation	4734	5804	4 HWh	54.7	55.8	2.3	9.5	15	13.1	13.6	11.7	.47
Early Baart	1697	5806	1 HWh	61.5	61.9	2.6	9.7	14	12.3	10.5	9.1	.48
Pacific Bluestem	4067	5807	5 HWh	50.5	52.4	2.6	9.5	15	12.7	15.6	14.1	.60
Fortyfold	5290	5808	4 HWhSm	55.4	56.8	2.6	10.4	14	11.7	13.5	12.7	.61
Kharkof	1442	5810	1 DHWn	61.7	62.8	1.7	10.0	15	12.8	10.7	9.5	.46
Marquis	4158	5803	5 DNS	52.2	53.5	3.2	10.0	15	13.1	15.4	14.4	.56

RESULTS OF MILLING AND BAKING TESTS.

Season and variety.	Quantity milled.	Milling tests.				Baking tests.					
		Flour.	Shorts.	Bran.	Loss.	Absorption of water.	Loaf.				
							Volume.	Weight.	Texture.	Color.	
										Score.	Shade.[b]
Crop of 1918:	*Gm.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*C. c.*	*Gm.*	*Per cent.*	*Per cent.*	
Hard Federation	1,400	72.4	13.1	13.0	1.5	61.5	2,280	504	93	92	CrGr
Federation	1,500	71.5	12.9	12.5	3.1	58.2	2,200	475	88	84	RGr
Early Baart	1,400	68.6	15.5	12.7	3.2	56.8	2,250	488	89.5	87	VGr
Pacific Bluestem	1,500	70.7	14.6	12.7	2.0	58.2	2,090	480	86.5	84	VGr
Fortyfold	1,400	72.2	13.5	11.7	2.6	53.8	1,750	457	83.5	83	VGr
Kharkof	1,500	68.8	15.2	13.8	2.2	62.1	2,100	501	89	89	CrGr
Marquis	1,400	71.7	14.3	14.0	0	57.6	2,600	483	91.5	88.5	Gr
Crop of 1919:											
Hard Federation	1,500	71.9	13.2	16.9	[c]2.0	62.9	2,110	511	91	92	Cr
White Federation	1,500	72.1	16.7	12.5	[c]1.3	61.8	2,070	506	93	93.5	CrGr
Federation	1,500	68.5	9.1	23.5	[c]1.1	56.5	2,120	489	88	91	VCr
Early Baart	1,500	71.8	10.7	17.7	[c].2	57.4	2,000	489	90.5	94.5	CrGr
Pacific Bluestem	1,500	66.1	9.0	26.3	[c]1.4	55.9	1,740	480	85	87	VCr&Gr
Fortyfold	1,500	65.5	12.1	22.1	.3	53.8	1,470	457	80	85.5	CrGr
Kharkof	1,500	71.3	14.5	16.7	[c]2.5	58.8	1,760	495	88.5	92	Cr
Marquis	1,500	69.9	15.5	18.1	[c]3.5	58.5	2,280	494	91.5	89	CrGr

[a] Abbreviations under "Grade:" D=dark, H=hard, N=northern, S=spring, Sm=smutty, Wh=white, Wn=winter.
[b] Abbreviations under "Shade:" Cr=creamy, Gr=gray, R=red, V=very.
[c] Gain.

The results for 1918 show that Hard Federation excels all other white wheats in weight per bushel, percentage of moisture, crude protein in the flour, yield of flour, absorption of water, and in volume, weight, texture, and color of loaf. Marquis exceeded it in crude protein in both wheat and flour and in volume of loaf. Kharkof had a greater weight per bushel. Federation proved to be inferior to Hard Federation, but it compared favorably with Early Baart and Pacific Bluestem and was much superior to Fortyfold.

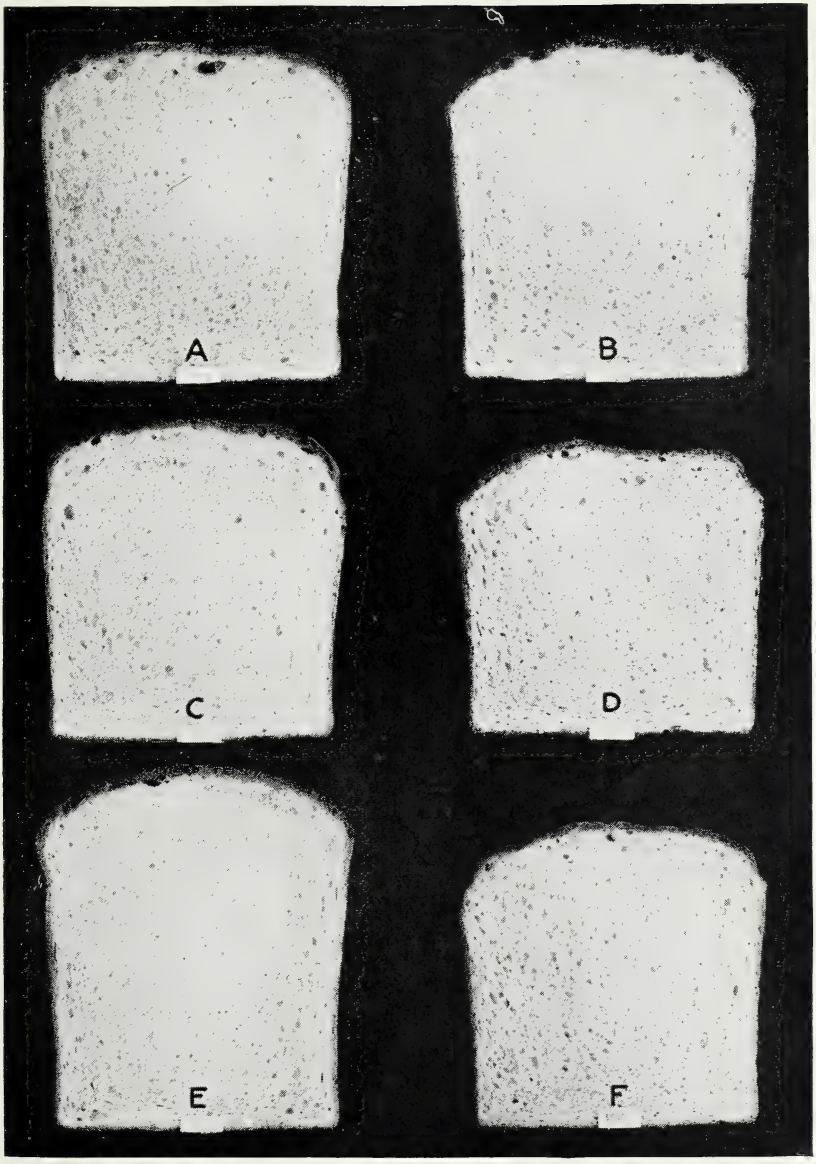
In 1919 Hard Federation again ranked high in weight per bushel, crude protein content, yield of flour, absorption of water, and in volume, weight, texture, and color of loaf. It was exceeded by Marquis in volume and by Kharkof and Early Baart in weight per bushel. It was exceeded in crude protein content by Pacific Bluestem because of the very low bushel weight of the latter. It was exceeded also by White Federation in weight per bushel, yield of flour, and in the texture and color of the loaf. Federation slightly exceeded Hard Federation in volume of loaf, but yielded a relatively low percentage of flour. Photographs of loaves of bread made from 340 grams of flour of Hard Federation, White Federation, Early Baart, Pacific Bluestem, Marquis, and Kharkof wheats grown at Moro, Oreg., in 1919, are shown in Plate III.

The two years' results would indicate that Hard Federation grown in the Columbia Basin of Oregon will produce grain of better milling and bread-making quality than the white wheats now grown and also better than Kharkof winter wheat and that it compares favorably with Marquis. Federation compares favorably with the commercial white wheats but is not significantly superior to them for milling and bread making. In the one year in which it has been grown White Federation has compared favorably with Hard Federation.

RESULTS FROM SAMPLES GROWN AT CHICO.

In the Sacramento Valley of California the wheat-growing industry has declined in recent years, partly because of the poor milling quality of wheat grown. Millers have claimed that the White Australian wheat has deteriorated in milling quality, and it was largely for this reason that the Early Baart variety was so extensively introduced into that section during the past year. The Sonora wheat is considered a poorer milling variety than White Australian, and the flour is not much used for bread making. The results obtained from milling Hard Federation, White Federation, and Federation in comparison with these wheats and Marquis and Kharkof grown at Chico, Calif., in 1918 and 1919 are shown in Table VIII.

In 1918 Hard Federation exceeded the commercial white wheats in absorption of water and in the texture and color of loaf. It was slightly exceeded by White Australian in yield of flour, crude protein content of wheat and flour, and volume of loaf.



SIX LOAVES OF BREAD MADE FROM VARIETIES OF WHEAT GROWN AT MORO, OREG., IN 1919.

These varieties, with the average loaf volume, are as follows: Hard Federation (A), 2,110 c. c.; White Federation (B), 2,070 c. c.; Early Baart (C), 2,000 c. c.; Pacific Bluestem (D), 1,740 c. c.; Marquis (E), 2,280 c. c.; Kharkof (F), 1,760 c. c.

TABLE VIII.—*Descriptive data and results of milling and baking tests of eight varieties of wheat grown at the Plant Introduction Station, Chico, Calif., in 1918 and 1919.*

[Data obtained in cooperation with the Bureau of Markets, United States Department of Agriculture.]

DESCRIPTIVE DATA OF WHEAT AND FLOUR.

Season and variety.	C. I. No.	Lab. No.	Grade.[a]	Bushel weight (pounds).		Screenings (per cent).	Composition (per cent).					
							Moisture content.			Crude protein (N × 5.7).		Ash in flour.
							Wheat.		Flour.			
				Before cleaning.	After cleaning.		Before tempering.	After tempering.		Wheat.	Flour.	
Crop of 1918:												
Hard Federation	4980	4768	2HWhSm	58.4	58.4	2.6	12.4	15	11.9	11.6	11.1	0.48
White Federation	4981	4764	2HWhSm	58.7	58.6	2.6	12.0	14	12.0	10.9	10.3	.55
Early Baart	1697	4770	3HWhSm	56.9	57.2	4.5	12.4	14	10.7	11.2	9.6	.47
White Australian	3019	5039	2HWhSm	59.7	60.0	3.5	9.0	14	11.4	12.8	11.7	.58
Sonora	3622	5040	1WhCSm	63.0	63.3	4.1	9.2	14	12.2	10.3	8.8	.48
Kharkof	1442	4766	2DHWn	59.4	60.0	3.8	10.4	15	10.2	14.1	12.3	.66
Marquis	4158	4765	1 NS	62.0	61.7	2.6	10.0	15	12.4	10.3	9.5	.66
Crop of 1919:												
Hard Federation	4980	5612	1HWh	62.2	62.3	1.7	11.2	14	13.1	9.1	7.6	.44
White Federation	4981	5622	1HWh	61.0	60.5	1.9	11.2	14	12.6	7.9	7.0	.55
Federation	4734	5618	2HWh	59.4	58.9	3.1	10.7	14	12.6	7.9	6.5	.44
Early Baart	1697	5629	2HWh	62.2	62.6	3.8	10.8	14	12.4	8.4	7.6	.50
White Australian	3019	5621	2SWh	59.5	59.8	2.2	10.3	14	13.3	7.2	5.4	.40
Sonora	3622	5625	1WhC	63.6	64.2	1.3	10.4	14	13.4	6.7	5.1	.37
Kharkof	1442	5613	2YHWn	59.7	60.8	1.4	11.4	14	13.3	7.9	6.4	.42
Marquis	4158	5628	1RS	60.1	60.9	.8	11.3	15	14.0	7.7	6.2	.41

RESULTS OF MILLING AND BAKING TESTS.

Season and variety.	Quantity milled.	Milling tests.				Baking tests.					
		Flour.	Shorts.	Bran.	Loss.	Absorption of water.	Loaf.				
							Volume.	Weight.	Texture.	Color.	
										Score.	Shade.[b]
Crop of 1918:	*Gms.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*C. c.*	*Gms.*	*P. ct.*	*P. ct.*	
Hard Federation	1,100	74.4	13.5	10.6	1.5	60.9	1,960	497	92.0	91.5	SlGr
White Federation	1,300	73.1	13.9	10.4	2.6	60.0	1,610	497	82.0	88.5	Gr
Early Baart	1,200	67.9	12.8	13.5	5.8	57.4	1,710	497	87.5	89.0	Gr
White Australian	1,300	75.4	12.7	11.1	.8	57.9	2,100	480	87.5	85.5	VGr
Sonora	1,300	73.0	16.5	10.6	c .1	57.6	1,850	479	86.0	85.5	CrGr
Kharkof	1,400	69.8	17.0	11.4	1.8	67.7	1,860	514	87.5	88.0	RGr
Marquis	1,400	76.4	12.6	11.2	c .2	59.1	2,000	481	92.0	94.0	SlGr
Crop of 1919:											
Hard Federation	1,290	72.6	17.2	11.9	c 1.7	58.5	1,930	502	94.0	97.0	SlCrGr
White Federation	1,250	73.2	16.0	10.7	.1	58.5	1,920	508	93.5	95.0	
Federation	1,250	73.1	14.4	12.8	c .3	53.8	1,960	487	91.0	93.0	Cr
Early Baart[d]	2,800	74.1	10.9	17.1	c 2.1	54.2	1,977	488	91.7	93.7	Cr
White Australian	1,280	73.4	14.0	12.5	.1	52.9	1,920	483	92.5	95.0	SlCr
Sonora	1,300	68.2	15.9	17.1	c 1.2	52.9	1,710	484	88.5	92.0	VCr
Kharkof	1,280	71.6	13.9	15.2	c .7	56.5	1,940	495	89.5	93.5	SlCrGr
Marquis	1,300	71.8	11.5	19.4	c 2.7	52.9	1,720	487	86.0	89.5	Cr

[a] Abbreviations under "Grade:" C=club, D=dark, H=hard, N=northern, R=red, S=spring, Sm=smutty, Wh=white, Wn=winter, Y=yellow.

[b] Abbreviations under "Shade:" Cr=creamy, Gr=gray, R=red, Sl=slightly, V=very.

[c] Gain.

[d] Average of two milling and three baking tests.

White Federation produced unfavorable results. The large yield of 50 bushels per acre would ordinarily reduce the milling value of the grain somewhat. This is possibly one cause for the unfavorable results.

In 1919 Hard Federation exceeded the commercial varieties in crude protein content of both wheat and flour, in absorption of water, and in weight, color, and texture of loaf. It was exceeded in weight per bushel by Sonora, in yield of flour by Early Baart and White Australian, and in volume of loaf by Early Baart. White Federation gave very favorable results, indicating a milling and bread-making value equal to that of Hard Federation. Federation also produced a high percentage of flour and a good loaf volume, but was lower than Hard Federation and White Federation in crude protein in the flour, in absorption of water, and in weight, color, and texture of loaf. Both Hard Federation and White Federation yield a higher percentage of shorts and a smaller percentage of bran than Early Baart. Hard Federation and White Federation are slightly exceeded in yield of flour by Early Baart and White Australian, but the higher percentage of crude protein, absorption of water, and weight, color, and texture of loaf obtained from both Hard Federation and White Federation offsets this advantage.

The experiments for two years, 1918 and 1919, indicate that Hard Federation grown in the Sacramento Valley of California will produce grain of better milling and bread-making quality than the white-kerneled varieties now grown there. Hard Federation also is a better milling and bread-making wheat than Marquis and Kharkof when the latter are grown in California.

SUMMARY OF MILLING AND BAKING RESULTS.

Milling and baking results from samples of Hard Federation flour representing four station years are available by combining C. I. No. 4733 and C. I. No. 4980. These can be compared with comparable samples of Early Baart, Kharkof, and Marquis and also of Pacific Bluestem by combining the results of White Australian with it. For other varieties data from only two or three station years are available. In the three station years in which the Hard Federation can be compared with White Federation and in the three station years when Hard Federation can be compared with Federation, Hard Federation evidently was the best milling and bread-making wheat of the three. All three are much superior in milling and baking value to the Fortyfold and Sonora varieties. White Federation and Federation both compare favorably in milling and baking value with Early Baart and Pacific Bluestem. The averages of the more important factors in the value of the varieties that can be directly compared in the four station years are shown in Table IX.

TABLE IX.—*Summary of milling and baking tests of five varieties of wheat grown at the Sherman County Branch Station, Moro, Oreg., and at the Plant Introduction Station, Chico, Calif., in 1918 and 1919.*

Variety.		Bushel weight.	Crude protein (N. × 5.7).		Yield of flour.	Absorption of water.	Loaf.		
Class and name.	C. I. No.		Wheat.	Flour.			Volume.	Texture.	Color.
White wheats:		*Pounds.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*C. c.*	*Per ct.*	*Per ct.*
Hard Federation	4733, 4980	58.9	12.6	11.6	72.8	61.0	2,070	92.5	93.1
Early Baart	1697	58.9	11.5	10.1	70.6	56.4	2,035	89.8	91.0
Pacific Bluestem	4067	55.8	12.8	11.3	71.4	56.2	1,963	87.9	87.9
White Australian	3019								
Red wheats:									
Marquis	4158	57.0	12.5	11.5	72.5	58.0	2,150	90.3	90.3
Kharkof	1442	60.1	11.0	9.7	70.4	61.3	1,915	88.6	90.6

The average data show that the Hard Federation exceeds Early Baart, Pacific Bluestem, Marquis, and Kharkof in practically all of the important milling and baking factors. In weight per bushel it is exceeded by Kharkof, in crude protein of the wheat by Pacific Bluestem, and in volume of loaf by Marquis. In all other comparisons Hard Federation ranks highest. The two years' data therefore indicate that Hard Federation is a better milling and bread-making wheat than Early Baart, Pacific Bluestem, or White Australian, is better than Kharkof when grown in these two sections of the Pacific coast area, and better than Marquis when grown in California.

The results obtained by the grain company and the flour company referred to from samples of wheat grown in 1919, at Moro, Oreg., and Chico, Calif., respectively, are in close agreement with our own experiments.

AUSTRALIAN WHEATS SUSCEPTIBLE TO DISEASE.

Experiments have shown that Federation, Hard Federation, and White Federation, as well as most other Australian varieties of wheat, are susceptible to black stem rust (*Puccinia graminis*), to the yellow stripe rust (*Puccinia glumarum*), and to the leaf rust (*Puccinia triticina*). They are also susceptible to bunt or stinking smut (*Tilletia foetens* and *Tilletia tritici*). In Australia they are also very susceptible to flag smut (*Urocystis tritici*) and to take-all (*Ophiobolus graminis*).

In the drier portions of the Pacific coast area black stem rust rarely occurs and, therefore, is not a factor in wheat production, as it is east of the Rocky Mountains. The yellow stripe rust, however, frequently occurs, but heavy infections have been noted without particular reduction of yields. There has never been a serious epidemic of stripe rust in the United States, although it is frequently very destructive in Europe. Some leaf rust generally occurs in the Pacific coast area, but it also is not destructive.

Bunt, or stinking smut of wheat, is the most destructive wheat disease in the Pacific coast area. In general, the Australian varieties are susceptible. Of all the varieties under experiment only Florence, Cedar, and Genoa have shown marked resistance. In Australia the two diseases known as flag smut and take-all are very destructive. They have been found only recently in the United States in limited areas.[1] Flag smut has thus far been found only in one county in Illinois. Take-all has been found in Indiana, Illinois, and Missouri. They have never been found in the Pacific coast area. In order to prevent the further introduction of these diseases into the United States a quarantine regulation was established August 15, 1919, preventing the importation of wheat except under permit from countries in which the diseases are known to exist.

CONCLUSIONS.

As a result of these investigations of Australian wheats in the matter of yields, water requirements, milling and bread-making value, and diseases, it has been decided to increase the stock of seed of the Hard Federation wheat at both Moro, Oreg., and Chico, Calif. White Federation also is being increased at Chico, because of its higher yield at that point. In 1920 both varieties will be under test at the agricultural experiment stations in several other sections of the Pacific coast area, and if favorable results are again obtained the increased quantity of seed will be distributed for commercial growing in the sections where the varieties appear to be best adapted.

SUMMARY.

The White Australian and Pacific Bluestem varieties of Australian wheat were long since found adapted to the Pacific coast area of the United States. These earliest grown varieties have been replaced in many sections recently by Early Baart, an earlier maturing, more drought resisting, higher yielding, and better milling Australian wheat.

Preliminary nursery experiments with about 130 lots of Australian wheats recently introduced give striking indications that Federation, Hard Federation, and White Federation are probably the best adapted of all varieties in two sections of the Pacific coast area. These have been compared with the leading commercial varieties for two years and have produced higher yields. Hard Federation has produced the larger yields in Oregon, while White Federation has outyielded it in California. One cause for the higher yield of Hard Federation over Early Baart is shown to be a lower water requirement in proportion to the grain produced.

[1] Humphrey, H. B., and Johnson, A. G. Take-all and flag smut, two wheat diseases new to the United States. U. S. Dept. Agr., Farmers' Bul. 1063, 8 p., 3 fig. 1919.

Experiments indicate that Hard Federation is superior for milling and bread-making purposes to the leading commercial varieties now grown in the Pacific coast area and also to Federation and White Federation wheats.

The Australian varieties in general are susceptible to most cereal diseases, but as many of these are not destructive in the Pacific coast area this is not considered a sufficient reason for not increasing their production.

The supply of the seed of the Hard Federation and White Federation is being increased for commercial distribution in those areas where each has been found best adapted.

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